Letters to the Editor.

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Uniform Motion in the Æther.

I SHOULD like to say a few words relative to Dr. Jeffreys's comments on my letter on the above subject in NATURE of August 11, p. 746.

Poincaré asserted that optical phenomena were, in his opinion, rigorously independent of any motion other than the relative motion of the bodies concerned, and this is, I believe, a cardinal tenet of relativity. In my judgment, the case of the moving mirror shows such rigorous independence to be logically impossible, but I do not quite gather whether Dr. Jeffreys accepts or rejects that point of view.

Allowing for the FitzGerald contraction, and also for the aberration, there will be, for an observer on the earth, a general apparent equality of the angles in question only when the motion of the earth is in the plane of the mirror. (I was guilty of a slip here, but so, I think, was Dr. Jeffreys, since, even disregarding the aberration, a motion of the earth normal to the mirror could scarcely allow of the same standard of angular equality for both earth and mirror, the motion of the latter in this case not being normal to its own plane.) Clearly, the existence of such equality determined by and determining one specific direction, is an optical phenomenon which depends on the absolute motion of the earth, not merely on the relative motions of earth and mirror; and if this be admitted it appears to me that the whole structure of relativity falls to the ground, in so far at least as it may not be able to dispense with logic.

As to other points, I believe that if Dr. Jeffreys will consider more closely the manner in which a distortion of the apparatus by the FitzGerald contraction would introduce discrepancies into stellar measurements, he will see that these discrepancies, if discriminable, would reveal, not the relative motion of stars and earth, but the absolute motion of the latter; and a comparison of this with the ordinary estimation of the earth's motion relative to the stars would show whether the whole material universe had a drift in space. Again, I do not find it possible to agree with Dr. Jeffreys that the Michelson-Morley experiment conducted through water would be of little interest. Indeed, it seems to me that this might constitute a crucial test of the whole theory. Supposing Fizeau's law for the light velocity in moving water to be of general application, I believe I am correct in saying that the change of length that must be suffered by the apparatus in the direction of the earth's motion, if the result of the experiment in water moving with the earth is to be negative, should be in the proportion

$$1 : 1 - \tfrac{1}{2}\frac{u^2v^2}{c^4}$$

instead of

$$1 : 1 - \tfrac{1}{2}\frac{u^2}{c^2},$$

as in the FitzGerald contraction, v being the velocity of light in water at rest in the æther and u being small. This would represent only about one-half of the latter contraction, and the test should therefore be decisive under the suppositions made. It is true that I have not allowed for the effect of the FitzGerald contraction upon Fizeau's law, but I do not know that there is general agreement as to the method of estimating this effect, and it seems very improbable that the result would be a complete elimination of v from the expression giving the contraction.

E. H. SYNGE.

Dublin, August 15.

IF we refer several events to the same system of position and time co-ordinates, and then consider the same events referred to another system, the position co-ordinates and times in the two systems are connected by a set of algebraic relations, called the Lorentz-Einstein transformation. The FitzGerald contraction refers only to a part of these relations between the co-ordinates; an argument that assumes it and omits to consider the other relations is not dealing with the principle of relativity. If the positions and times in two systems of reference B and C are connected with those in another system A by such transformations, those in system C can be found in terms of those referred to B by algebra, and it is found that the relation between B and C is another Lorentz-Einstein transformation, and involves no mention of A whatever.

In Mr. Synge's problem of the mirror, we may call the "æther" system A, the earth system B, and the mirror system C. Even if there was a fundamental æther, his suggested experiment deals only with the relations between B and C, and, in consequence of the above theorem, can therefore be treated in terms of their relative motion alone. The "absolute" motion never enters into the question. It would enter, of course, if we tried to tackle the problem by referring everything to system A, but it would be found that the absolute motion eliminated itself when the angles of incidence and refraction were compared. Aberration does not affect the problem, for it increases or reduces both angles equally.

I see no reason to alter anything in my previous note. It is perfectly true that the theory of relativity makes certain positive predictions, and would have to be modified seriously if any of these were proved false by experiment. But it is not true that it predicts anything that involves the absolute motion of the earth in space. Nothing but experiment could refute it; its self-consistency is perfect.

HAROLD JEFFREYS.

Relation of the Hydrogen-ion Concentration of the Soil to Plant Distribution.

IN a series of papers from 1916 onwards Wherry has studied the relation between soil reaction and plant distribution in the United States. He made use of colour tests with indicators for determining the hydrogen-ion concentration of the solution obtained by agitating soil taken near the plant with water. In this manner he showed that the distribution of a species may be limited in a very definite way by the soil reaction, in expressing which it is convenient to record the results in terms of the logarithm of the reciprocal of the hydrogen-ion concentration in grams per litre. This is denoted by the symbol pH, neutrality is at pH7, centi-normal hydrochloric acid is at pH2, and sea-water at about pH8.

Wherry has given the limits for a number of American plants, and shown the soil reaction to be expected in various types of soil. A paper dealing with the subject has also appeared recently in Sweden, giving results obtained by O. Arrhenius, but this is not accessible here as yet.

During the last year determinations of the pH values of soils have been carried out by the writer in India and the British Isles with the view of extending our knowledge of plant distribution. It has been

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found that Java indigo can tolerate wide changes in reaction, growing in Bihar in soil at *p*H8·7 and in Assam at *p*H5·4. It, however, does much better in the latter for various reasons.

In the British Isles it has been found that the yellow stonecrop, *Sedum acre,* flourishes in soil from *p*H7 to 8 or over, whereas the white *S. anglicum* may be growing at from *p*H6·8 to 5·1, possibly slightly outside these limits. Plants which are by some regarded as typical species of limestone districts may be found elsewhere provided the soil reaction is suitable; thus *Salvia verbenaca* grows between *p*H7 and 8, *Crithmum maritimum* around *p*H8, and *Cochlearia danica* from *p*H7·5 to 8, possibly over it, much the same range being occupied by *Linaria cymbalaria*; for *Centranthus ruber* values from *p*H7·4 to 8·8 have been obtained. The common gorse, *Ulex europaeus* is usually found on acid soil; in seven cases where it was observed growing in abundance the reaction was *p*H6·8 to 5·4, but one plant was found at *p*H8·1, one at 8·2, and three or four at 8·6. In other cases the soil was probably alkaline, but was not tested.

The sea pink, *Armeria maritima,* may be found between *p*H6·8 and 8·2, but the typical sand-dune plants, *Ammophila arenaria, Euphorbia Paralias, Salsola Kali,* are found only in the neighbourhood of *p*H8.

Moorland plants, *Erica tetralix, Anagallis tenella, Drosera rotundifolia, Jasione montana,* etc., are commonly found at *p*H5·5 to 5, or thereabout, but the limits are certainly wider.

The accumulation of data of this type is of necessity a slow process, but one cannot fail to be impressed by the fact that the presence or absence of a plant in a given locality stands in close relation to the hydrogen-ion concentration of the soil. Plants may survive, or even do well, in cultivation outside their normal limits, but in free competition with their neighbours the soil reaction is often the deciding factor—always, in fact, if the divergence from the normal *p*H value for the species is sufficiently great.

Considerable changes in the soil reaction may be met with in quite a short distance. Thus on crossing a road at Youghal, Co. Cork, one passes from a soil of about *p*H7·5, with *Salvia verbenaca* and *Ononis arvensis,* to an acid soil, *p*H6·8 to 6·4, with gorse, and in the wet parts *Iris pseudacorus* and bog-cotton. This, in turn, passes into sandy pasture and sand dune, the latter giving about *p*H8. Again, near Cawsand, in Cornwall, gorse is plentiful on the felsite soil at *p*H6·4 to 5·4, but absent from the adjacent, and similarly situated, soil of the Staddon Grits, which normally gives *p*H7 to 7·8.

It appears as if corresponding differences are shown by water-plants and fresh-water algæ, the upland waters which are very slightly acid or almost neutral favouring the desmids. There is much room for further work along these lines.

W. R. G. ATKINS.

August 30.

“Smoky” Quartz.

THE deeply tinted varieties of quartz, such as “smoky” quartz and the yellow or Madagascar variety, are generally transparent in the infra-red region of the spectrum to the same extent as clear rock-crystal, as may easily be demonstrated with the aid of a thermopile and galvanometer. I wish to suggest that a very simple physical explanation of this property may be offered. As has been emphasised in a paper by Prof. R. J. Strutt (now Lord Rayleigh) in the Proceedings of the Royal Society for 1919, these varieties of quartz are really optically turbid media, the opacity arising from the scattering of the radiations in their passage through the crystal by a cloud of small particles present as inclusions. Since scattering of this kind is effective in inverse proportion to the fourth power of the wave-length, it can easily be seen why the longer heat-waves can traverse the crystal without appreciable loss. Some photometric observations which I have made of the relative transparency of the yellow and colourless varieties in different parts of the spectrum support this explanation.

In the paper just quoted Rayleigh has described the very beautiful and striking effects that arise owing to optical rotatory dispersion when a strong beam of *polarised* light is sent through a block of smoky or yellow quartz in the direction of the optic axis; the track of the beam, as made visible by the scattering particles and observed in a transverse direction, shows bright and dark bands if monochromatic light be used, and alternations of colour if the incident beam is of white light, the effect being due to the fact that the scattering particles themselves act as *analysers* of the light incident on them. I find that the phenomenon discovered by Lord Rayleigh can be very prettily shown in another way which is also instructive. A thin, flat sheet of *unpolarised* white light may be sent through the crystal in a direction *transverse* to the optic axis, and the track of the beam observed in a direction parallel to the optic axis through a Nicol. In this case the scattering particles act as *polarisers,* and the scattered light suffers a rotatory dispersion of its plane of polarisation in traversing the quartz along the optic axis before reaching the observer's eye. Hence the whole track of the beam as seen through the observing Nicol appears coloured, the tint fluctuating periodically with the thickness traversed as the block is moved to and fro in the line of sight or when the analysing Nicol is rotated.

Rayleigh has shown in his paper that the track of a beam of light traversing a beam of *transparent* colourless quartz can be successfully photographed. I find that by using a concentrated beam of sunlight it is possible *visually* to detect the Tyndall blue cone even in this case. Its intensity, however, is exceedingly small.

C. V. RAMAN.

22 Oxford Road, Putney, S.W.15,
September 4.

Brown Bast and the Rubber Plant.

IN NATURE of June 16 (p. 499), in a paragraph which announces the discovery by the Botany Department of the Imperial College of Science and Technology that “‘brown bast’ (the most serious disease of *Hevea brasiliensis*) is essentially a question of phloem necrosis,” it is stated that Sanderson and Sutcliffe have shown that “burrs result from the inclusion of areas of diseased laticiferous tissue in stone-cell ‘pockets’ formed by the activities of wound cambiums.”

It should be pointed out that the presence of latex vessels in the core of nodules (burrs) was first recorded by Bateson (Agric. Bulletin Fed. Malay States, August, 1913, p. 24), and later corroborated by Richards and Sutcliffe (“*Hevea brasiliensis,*” 1914, Malay Peninsula Agric. Assoc.), and by myself (Bulletin 28, Dept. of Agric., Ceylon, October, 1916, and Annals Roy. Bot. Gdn., Peradeniya, vol. 6, p. 257, 1917).

Workers in Java have further confirmed this inclusion of laticiferous tissue as regards the nodules which follow brown bast, and the fact that nodules in the most general case result from the inclusion of areas of diseased laticiferous tissue has been common knowledge in the East for the last five years. That the formation of nodules after brown bast is a secondary

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